The role of hemogram parameters in predicting the severity of preeclampsia

Predicting the severity of preeclampsia

Mulaim Sizer[1], Nurullah Peker[2], Reyhan Gündüz[2], Mehmet Sıddık Evsen[2], Nebahat Sunar[2], Hamdin Günsel[1]
[1] Department of Obstetrics and Gynecology, Batman Training and Research Hospital, Batman
[2] Department of Obstetrics and Gynecology, Faculty of Medicine, Dicle University, Diyarbakır, Turkey

Abstract

Aim: The purpose of this study was to examine the significance of hemogram parameters in predicting preeclampsia and/or preeclampsia severity in patients with pre-diagnosis of preeclampsia.

Material and Methods: The study was retrospective and comprised 198 patients with preeclampsia, 158 with severe preeclampsia and 40 with non-severe preeclampsia, as well as 126 pregnant women who had a healthy pregnancy as the control group. From the hemogram parameters, platelet count (PLT), neutrophil count, mean platelet volume (MPV), mean erythrocyte volume (MCV), leukocyte count and neutrophil/lymphocyte ratio (NLR), platelet/lymphocyte ratio (TLR) and platelet/neutrophil ratio (TNR) were calculated. The pregnant women included in the study were compared in terms of these parameters.

Results: While there was no statistically significant difference between the groups in the statistical analysis of MCV, MPV, NLR, and TNO, which are the parameters studied in PE groups with and without severe features, a statistically significant difference was found in these parameters between the control group and the preeclampsia group. At the TNO 35,1250 cut-off value, the sensitivity was 83.8 %, the specificity was 41.3 %, the positive predictive value was 69.17 %, and the negative predictive value was 61.90 %, and it was found that this value predicted the presence of PE as 69%.

Discussion: In this study, we discovered that MPV, MCV, TNO, and NLO levels differed significantly between the PE and control groups. However, the sensitivity and specificity rates of these parametria in the detection of preeclampsia are far below significant values.

Keywords

Hemogram, MCV, MPV, NLR, PLR, PNR, Preeclampsia

Introduction

Preeclampsia (PE) is a disorder in which a previously known normotensive pregnant woman develops new-onset hypertension with severe end-organ dysfunction signs or symptoms in the absence of proteinuria or new-onset hypertension with proteinuria after 20 weeks of gestation [1, 2]. According to a comprehensive review, PE complicated 4.6 % of all pregnancies [3]. Although there are risk factors for PE such as nulliparity, history of PE in a previous pregnancy, age over 40 or under 18, family history of PE, chronic hypertension, chronic kidney disease, autoimmune disease (such as antiphospholipid syndrome, systemic lupus erythematosus), vascular disease, Diabetes Mellitus (DM) (pregestational DM or gestational DM), multiple pregnancies, obesity, black race, hydrops fetalis, the basic causes of this disease have not been clearly clarified yet despite many studies. Studies examining the association between markers of systemic inflammation, which may be easily obtained via a complete blood count (hemogram), and various diseases have recently received a lot of interest [4-9].

In this study, platelet count (PLT), neutrophil count, leukocyte count, mean platelet volume (MPV), mean erythrocyte volume (MCV) in the hemogram examination taken from the patients at the time of admission and neutrophil/lymphocyte ratio (NLR), platelet/lymphocyte ratio (TLR), platelet/neutrophil ratio (TNR), which are called systemic inflammatory response markers, obtained by the ratio of some of these parameters were taken into account. It was intended to assess the role of the analyzed parameters in predicting preeclampsia or the severity of preeclampsia.

Material and Methods

A total of 198 pregnant women with preeclampsia (Pe group), 158 with severe preeclampsia and 40 with non-severe preeclampsia (Pe group), who applied to the Gynecology and Obstetrics Clinic of local University Medical Faculty Hospital between January 2018 and December 2019, were included in the study by retrospectively scanning their files. The 2019 ACOG guidelines were based on the diagnosis of preeclampsia and the classification of preeclamptic patients as having severe or non-severe characteristics [1]. Pregnant women with any infection detected, with diagnoses such as DM, chronic hypertension, chronic lung, kidney and heart disease and chronic drug use, multiple pregnancies, developing chorioamnionitis, malignancy, hospitalized in our clinic with the diagnosis of PE and followed up with eclampsia or HELLP (Hemolysis , Elevated Liver Enzymes, Lowered Platelet), and patients who came to our clinic with full cervical dilation under emergency conditions and gave birth before hemogram could be examined, or patients who gave birth in another center and were sent to our clinic because of PE development in the postpartum period were not included in the study. The control group consisted of 126 pregnant women who had a healthy pregnancy.

Hemogram samples were collected from patients prior to any surgical intervention or medicinal therapy. To compare groups, mean platelet volume (MPV), mean red cell volume (MCV), neutrophil/lymphocyte ratio (NLR), platelet/lymphocyte ratio (TLR) and platelet/neutrophil ratio (TNR) were measured. Hemogram parameters were also studied and calculated in the

Sysmex XN – 1000 (Japan) model.

Statistical Package for Social Sciences (SPSS) for Windows 21 (IBM SPSS Inc., Chicago, IL) statistical package program was used for the statistical evaluation of the research data. Categorical variables were shown as numbers and percentages, whereas measured variables were provided as mean standard deviation (SD), minimum maximum (min-max), or median (25-75 percentile) (%). The Shapiro-Wilk test was used to determine whether the data conformed to the normal distribution. Mann Whitney U test was utilized in the analysis of measurement variables. The chi-square test was performed in the analysis of categorical data. The hypotheses were two-sided, and a $p<0.05$ was considered statistically significant. To determine the distinctness of the hemogram parameters measured in the process of determining the presence or severity of preeclampsia, ROC (Receiver-operation characteristic) analysis was performed.

Ethical Approval

This study was approved by the Ethics Committee of the local University Faculty of Medicine Non-Invasive Clinical Research (Date: 2020-07-16, No: 246).

Results

The study comprised 324 pregnant women, 126 of whom were in the control group and 198 of whom were PE patients. Pregnant women with preeclampsia were divided into two groups: those with non-severe preeclampsia (n=40) and those with severe preeclampsia (n=158).

In terms of maternal age at birth, gravida, parity abortion, and the number of survivors, there was no significant difference between the two groups (p>0.05).

In terms of fetal weight, fetal height, 1st and 5th minute APGAR scores, and the gestational week at the time of birth, there was a significant difference between the two groups (p0.001).

A statistically significant difference in MCV, MPV, NLR, and TNO was found between the two groups, and the comparison of laboratory values is given in Table 1.

Below is the ROC curve and analysis for MCV, MPV, TLR, NLR, and TNO levels in the preeclampsia and control groups.

The sensitivity was 59.1 %, the specificity was 52.4 %, the positive predictive value was 66.10 %, and the negative predictive value was 44.90 % for MCV 84.4(fL). The MCV 84.4(fL) cut-off value was found to predict the occurrence of PE 56.6 %. (p<0.045).

Table 1. Comparison of laboratory data of preeclampsia group and control group

Parameters	PE Group (n=198) Median (%25-%75)	Control Group (n=126) Median (%25-%75)	p
MCV fL	85,93 (80,62-89,46)	84,18 (77,81-88,55)	0,045
PLT 10e3/uL	209,25 (172,75-263,75)	228,45 (188,15-272,92)	0,005
MPV fL	10,95 (8,80-13,15)	10,39 (8,44-11,99)	0,024
Lymphocyte 10e3/uL	2,09 (1,51-2,52)	2,06 (1,76-2,42)	0,273
Neutrophil 10e3/uL	8,89 (6,888-11,34)	7,05 (5,85-9,39)	<0,001
TLO	103,80 (78,79-134,75)	108,89 (92,78-137,67)	0,078
NLO	4,15 (2,93-6,66)	3,65 (2,75-4,51)	<0,001
TNO	24,17 (17,63-32,07)	29,41 (24,38-42,46)	<0,001

PE: Preeclampsia

Table 2. MCV, MPV, TLR, NLR, and TNO levels were evaluated for their diagnostic efficacy in distinguishing pregnant women with preeclampsia from normal pregnancies

	Cutoff	Sensitivity %	Specificity %	% 95 CI	AUC%	PPD	NPD	p
MCV	84.40	59.1	52.4	0.502-0.630	56.6	66,1	44,9	0.045
MPV	Eyl.81	65.0	40.5	0.511-0.637	57.4	63,05	50	0.024
TLO	108.85	57.6	50.0	0.496-0.620	55.8	64,41	42,86	0.078
NLO	32.313	69.7	45,2	0.570-0.691	63.1	66,67	48,72	<0.001
TNO	351.250	83.8	41.3	0.633-0.748	69.0	69,17	61,9	<0.001

AUC: area under the curve, CI: confidence interval, PPD: positive predictive value, NPD: negative predictive value, p: statistical significance value

Table 3. Laboratory parameters of the non-severe preeclampsia group and the severe preeclampsia group were compared

Parameters	Non-severe Preeclampsia group (n=40)	Severe Preeclampsia group (n=158)	p
MCV fL	86,29 (83,38-90,16)	85,61 (79,73-89,40)	0,35
PLT 10e3/uL	209,90 (180,80-277,60)	208,60 (163,60-260,80)	0,65
MPV fL	10,72 (9,08-12,46)	10,96 (8,80-13,18)	0,419
Lymphocyte 10e3/uL	2,09 (1,50-2,77)	2,10 (1,52-2,50)	0,65
Neutrophil 10e3/uL	8,23 (7,01-9,15)	9,36 (6,85-12,15)	0,089
TLO	97,75 (79,30-139,22)	104,22 (78,15-133,26)	0,868
NLO	3,64 (2,77-5,85)	4,33 (3,01-7,66)	0,107
TNO	25,57 (21,57-33,88)	23,64 (15,66-31,95)	0,155

Figure 1. ROC curve for MCV, MPV, TLO, NLO and TNO levels for preeclampsia group and control group

The sensitivity was 65.0 %, the specificity was 40.5 %, the positive predictive value was 63.05 %, and the negative predictive value was % for MPV 9.81(fL). MPV ≥9.81(fL cutoff value predicted the presence of PE was 57.4%(p<0.024).

For NLR ≥3,2313, sensitivity was 69.7%, specificity 45.2%, positive predictive value 66.67% and negative predictive value 48.72%. NLR ≥3,2313 cutoff value predicted the presence of PE was found to be 63.1% (p<0.001).

TNR ≤35,1250 had a sensitivity of 83.8 %, a specificity of 41.3 %, a positive predictive value of 69.17 %, and a negative predictive value of 61.90 %. TNO ≤35,1250 cut-off value

predicted the presence of PE was found to be 69.0% (p<0.001). When the laboratory parameters of the non-severe PE group and the severe PE group were compared, no statistically significant difference in any parameter was identified (Table 3).

Discussion

Preeclampsia is a progressive condition that endangers both the mother's and the baby's health. Although the exact etiology is unknown, new research suggests that preeclampsia is connected with increased inflammation and aberrant immunological responses [10]. Early detection of low-cost and easily accessible measures may aid in the treatment of preeclampsia and difficult pregnancy outcomes. Systemic inflammatory indicators are hemogram parameters that can be examined in practically any health clinic. In this study, MPV, MCV, TNO, and NLR were found to be significant in predicting preeclampsia. Simultaneously, TNO was found to be a greater predictor of preeclampsia than NLR, MPV, and MCV. While Elgari et al. showed [11] that MCV was considerably greater in the PE group compared to the control group in one of the studies exploring the association between preeclampsia and MCV, Kanat-Pektaş et al. [12] observed no statistically significant difference in MCV between the two groups. In both studies, the reason for this difference was not emphasized. When the association between MPV and PE is explored, it is discovered that the MPV value in the PE group is much higher than in the control group [13]. In conclusion, when similar research is reviewed further, it is clear that MCV and MPV are higher in the PE group [12, 14]. MCV and MPV levels were observed to be considerably higher in the PE group compared to the control group in our study. Elgari et al. found that the mean MCV in the PE group was 86 ± 6.2 fL (p<0.001), while the mean MCV in the control group was 83 ± 8.1 fL [11]. Although the MCV value was greater in the PE group compared to the control group in the study by Kanat-Pektaş et al., no statistical difference was detected between the two groups [12]. In both studies, no comment was made on the cause of MCV elevation. In another study, it has been reported that MCV is increased in preeclampsia [14].

There are many studies in the literature examining the relationship between NLR and preeclampsia because the Neutrophil/Lymphocyte Ratio is shown as an easily accessible marker showing the prognosis of systemic inflammation and some diseases, and increased systemic inflammatory response is considered in your PE etiopathogenesis. Although there is no clear consensus between NLR and PE in studies, most investigations show that NLR values in PE are much greater
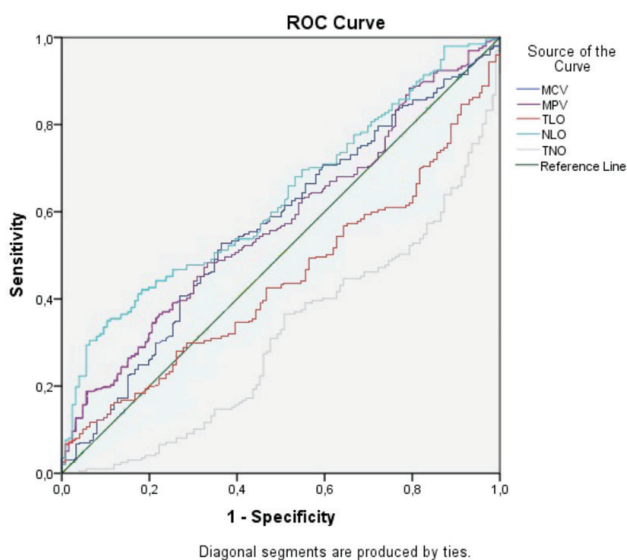
than in the control group [15-17]. This appears to be consistent with the concept of systemic inflammatory response in the pathophysiology of PE. NLR was significantly higher in the PE group in this study, but there was no significant difference between the severe PE group and the non-severe PE group.

TLR, like other systemic inflammatory indicators, has been assumed to be a predictor of the existence and severity of PE, however, despite inconsistent data to yet, the trend is that there is no difference in TLR between PE and the control group [18, 19]. Similarly, no significant change in TLR was found between the PE and control groups in our investigation.

There are very few studies that examine TNO to predict the existence or severity of preeclampsia, and in our investigation, the TNO value was considerably lower in the PE group compared to the control group. At the TNO 35,1250 cut-off value, the sensitivity was 83.8 %, the specificity was 41.3 %, the positive predictive value was 69.17 %, and the negative predictive value was 61.90 %, and it was found that this value predicted the presence of PE as 69% .

To summarize, preeclampsia is a major cause of neonatal and maternal death. Early detection and treatment will lower fetal-maternal morbidity and mortality rates dramatically. In this study, we discovered that MPV, MCV, TNO, and NLO levels differed significantly between the PE and control groups. However, the sensitivity and specificity rates of these parametria in the detection of preeclampsia are far below significant values. Furthermore, it was decided that multicenter studies with bigger patient populations are required to evaluate whether they can be used alone in diagnosing and forecasting the severity of preeclampsia.

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